9th foundation

<u>WS-6</u> work

<u>Task</u>

①

$F = 10N$; $S = 2m$ the body is displacing in the direction of force $\therefore \theta = 0°$

$W = FS\cos\theta$

$= 10 \times 2 \times \cos 0$

$= 20J$

②

$S = 5m$; $W = 25J$ F & S are in same direction

$\theta = 0°$

$\therefore W = FS\cos\theta$

$\Rightarrow 25 = F \times 5 \times \cos 0°$

$\Rightarrow \overset{5}{\cancel{25}} = \cancel{5}F$

$\Rightarrow F = 5N.$

③

Given $F = 15N$; $W = 45J$

F and S are in same direction

$\theta = 0°$

$\therefore W = FS\cos\theta$

$\Rightarrow \overset{3}{\cancel{45}} = \cancel{15} \times S \times \cos 0$

$\Rightarrow 3 = S \times 1 \Rightarrow S = 3m$

④

In 12 hrs the hours hand completes one rotation

so displacement $s = 0$

$w = F\ s\ \cos\theta$

$w = F\ (0)\ \cos\theta = 0$

⑤

Given $m = 2kg$; $h = 2m$; $g = 10\ m/s^2$

work done $= F\ s\ \cos\theta$

$= mg\ h\ \cos 180°$

Here G.F is acting downwards and body displacement is upwards so that $\theta = 180°$

$w = -mgh$

$= -2 \times 10 \times 2$

$= -40J$ '-ve' sign shows work is done against gravity.

⑥

Given $h = 10m$; $w = 50J$; $g = 10m/s^2$

∴ work done $= F\,S\,\cos\theta$

F = gravitational force and s = h are in opposite direction, $\theta = 180°$

$w = mgh\ \cos 180$

$\Rightarrow 50 = m \times 10 \times 10\ (-1)$

$\Rightarrow m = 50 \times 10^{-2} = 0.5$ kg

⑦

Given $\omega = 30\,J$ $m = 1\,kg$.

From $\omega = F S \cos\theta$ $F = mg$; $S = h$

$\theta = 180°$

$\Rightarrow 30 = mgh \cos 180$

$\Rightarrow 30 = 1 \times 10 \times h \times (-1)$ work is done against gravity

$\Rightarrow 3\cancel{0} = \cancel{10}h$ So we get -ve sign.

$\Rightarrow h = 3m$

⑧

$m_m = 3\,kg$; $h_m = 5\,m$

$\omega_m = 5\,J$

From $\omega = mg\,h$

$\Rightarrow \cancel{5} = 3 \times g_m \cancel{5}$

$\Rightarrow 1 = 3\,g_m \Rightarrow g_m = \frac{1}{3}$

⑨

$\frac{W_e}{W_m} = \frac{5}{3}$ $h_e = h_m$.

we know work done in lifting the body is

$\omega = mg\,h$

$\frac{W_e}{W_m} = \frac{g_e}{g_m}$

$\Rightarrow \frac{g_e}{g_m} = \frac{5}{3}$

⓪

$h_e = 1m$, $h_m = 6m$.

we know work done in lifting the body is

$w = mgh$ [w = same, m = constant]

$g \propto \cancel{k} \frac{1}{h}$

$\Rightarrow \frac{g_e}{g_m} = \frac{h_m}{h_e}$

$\Rightarrow \frac{g_e}{g_m} = \frac{6}{1} \Rightarrow g_m = \frac{1}{6} g_e.$

Advanced

⑪

ⓐ Since the direction of frictional force is always opposite to the motion of a body so the angle between frictional force and displacement is 180°

Since $\cos 180° = -1$

$w_{friction} = f s \cos 180 = -f s$

ⓑ If the body is Projected vertically up Gravitational force and displacement are opposite
$\therefore \theta = 180°$

$w_{G.F} = \cancel{m} F_g \, s \cos 180$

$= mgh \, (-1)$

$= -mgh = -ve.$

a, d are correct

⑫

ⓐ As the body lifted up a force of equal in magnitude as that of weight (mg) of the body is applied in upward direction.

∴ $F_{applied}$ and displacement are in same direction so $\theta = 0°$

$\therefore \omega = F_{app}\ S \cos 0°$

$\Rightarrow mg\,h\,(1) = mgh = +ve$

ⓑ

Here gravitational force and displacement are in opposite direction. Hen $\theta = 180°$

$\omega = F_g\ S \cos\theta$

$= F_g\ S \cos(180°) = -F_g S = -ve$

$\omega_{Total} = \omega_{app} + \omega_g = mgh + (-mgh) = 0$

⑬ (13)

(a) The direction of centripetal force and ~~displacement~~ displacement are Perpendicular so work done $= F_c\ S \cos 90° = 0$

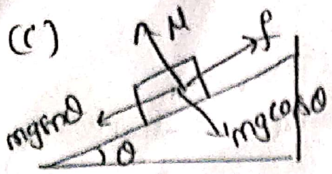
(b) Tension in string and displacement are Perpendicular

$\omega = T\ S \cos 90° = 0$

(c) Displacement of Person is $S=0$ ∴ $\omega = F_g S \cos\theta = 0$

⑦ ⑭

(c)



work done by the gravity

$W_g = F_g\ s\ \cos$

$= (mg \sin\theta) s.$

(a) Direction of friction is opposite to that of direction of motion of the body. so $\theta = 180^\circ$

$W = f\ s\ \cos\theta$

$= f\ s\ \cos 180^\circ \Rightarrow W = -\underline{fs} = -ve$

⑧ ⑱

a) If $\theta = 0 \rightarrow W = FS\cos\theta = FS\cos 0 = FS = +ve$

b) If $\theta = 180^\circ \rightarrow W = FS\cos 180^\circ = FS(-1) = -FS = -ve$

c) If $\theta = 90^\circ \rightarrow W = FS\cos 90^\circ = FS(0) = 0.$

⑨, ⑩

Given $m = 3\ kg$; $h = 10m$; $F = 5N$

work done by gravity $= F_g S\cos\theta = mgh\cos(180)$

$= -mgh = -3 \times 10 \times 10 = -300N$

work done by applied force $W = F_{app} S\cos\theta = 5 \times 10 \times \cos 0$

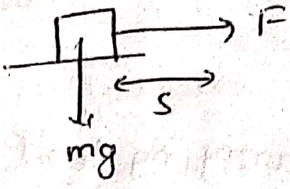
$= 50N.$

F_{app} & S are in same direction so $\theta = 0^\circ$

F_g & S are in opposite direction so $\theta = 180^\circ$ body is is lifting.

③

we know work done $w = FS\cos\theta$



Here s and mg are Perpendicular

$\theta = 90$

$w = FS\cos 90 = 0$

④

If any body is in rotatory motion force and displacement are Perpendicular $\theta = 90°$

$w = FS\cos 90° = 0$

⑧

when box lifted from ground

work done = mg h

mg → weight of box.

⑩

we know Work done = $FS\cos\theta$

If $\theta = 0$; $\cos\theta = \cos 0 = 1$

$\theta = 90$; $\cos 90 = 0$. when force and displacement are perpendicular then $w = FS\cos 90$

$= 0$

Jee mains level

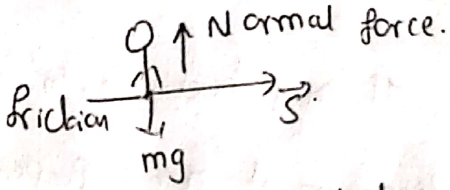
①

work done $w = F S \cos\theta$

work done does not depends on mass.

③

when a person carrying load on his head walks on a horizontal road



Here Normal force and gravitational force displacer are Perpendicular so $\theta = 90°$; $\cos 90° = 0$

$w = 0$.

friction and displacement are antiparallel

$\theta = 180°$ $\cos 180° = -1$ $w = -ve$.

④

when electron is revolving around the orbit

Force and displacement are perpendicular so $\theta = 90$

$w = FS \cos 90 = 0$.

when porter carrying a suitcase there is a gravitational force acting perpendicular to displacement of porter.

$\therefore \theta = 90°$ $w = FS \cos 90$

$w = 0$

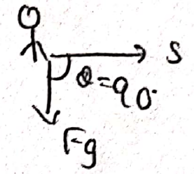
Both A & B are true

L Task

Jee mains level

⑤

ⓐ As the porter is walking displacement of porter's $\vec{s}$ is ⊥r to gravitational force F_g



$\theta = 90°$

$w = F_g \, s \cos 90 = 0$

ⓑ

Here suitcase was lifting i.e. displacement (h) is upwards and gravitational force is downward ↓

$\therefore \theta = 180°$ $\quad w = F_g \, s \cos 180 = -F_g h$

ⓒ

work done by external force F to move suitcase along inclined plane through a vertical height h

$w = F s \cos\theta$

c, a, b option D

⑥

Given $F = 20N$; $s = 2m$: F & S are in same direction

$\therefore \theta = 0°$

$W = F s \cos\theta$

$\Rightarrow W = 20 \times 2 \times \cos 0$

$= 40J$

⑦

Given $S = 2m$; $W = 10J$. ; [F & S are in same direction] $\theta = 0°$

$W = FS\cos\theta$

$\Rightarrow 10 = F \times 2 \times \cos 0$

$\Rightarrow 10 = 2F \Rightarrow F = 5N$

⑧

Given $F = 25N$; $W = 75J$ $\theta = 0°$

$W = FS\cos\theta$

$\Rightarrow \underset{3}{\cancel{75}} = \cancel{25}\ S\cos 0°$

$\Rightarrow 3 = S \Rightarrow S = 3m$

⑨

In 1 hr the minute hand completes one rotation so. displacement is zero.

$\therefore W = FS\cos\theta = F(0)\cos\theta = 0$.

⑩

Given $m = 3kg$; $h = 5m$

$W_{g.f} = mgh$

$= 3 \times 10 \times 5$

$= 150J$

(5)

(a)

$W = FS\cos 90^\circ = 0$

(b) workdone by the g·F of a suitcase when it is lifted from the ground to a height

$W = mgh\cos 180^\circ = -mgh.$

(c)

work done by the external force along an inclined plane through a vertical height 'h'

$W = mg\,l\sin\theta = mgh$

Decreasing orde C, a, b

(6)

Given $F = 20N$; $S = 2m$. F & S are in same direction.

$W = FS\cos\theta$

$= 20\times 2\times\cos 0$

$= 40J$

(7)

work done $= 10J$; displacement $S = 2m$.

We know $W = FS\cos\theta$

$\Rightarrow 10 = F\times 2\times\cos 0^\circ$

$\Rightarrow F = 5N.$

⑧

Given $F = 25N$; $w = 75J$,

we know $w = FS \cos\theta$

$\Rightarrow \overset{3}{\cancel{75}} = \cancel{25} \times S \cos 0$

$\Rightarrow 3 = S \rightarrow S = 3m$.

⑨

In 1 hr. Time for one rotation of min han completes $S = 0$.

$W = FS \cos\theta = 0$.

⑩

Given $m = 3kg$; $h = 5m$

work done $= mgh = 3 \times 10 \times 5 = 150 J$.

⑰

Given $m = 1 kg$; $S = 1m$. $F = 8N \rightarrow$ horizontal

vertical distance $s = 2m$

work done by Gravitational force $= mg\ h$

$= 1 \times 10 \times 2 = 20J$

work done to displace horizontally $w = F \cdot S$

$= 8 \times 1$

$= 8\ J$

⑱

Given $F = 5N$; $V = 2\,m/s$; $m = 10\,kg$.

$t = 60$ sec. ; ~~$a = \frac{V}{t} = \frac{2}{60}$.~~ ~~$a = \frac{F}{m} = \frac{5}{10} = \frac{1}{2}\,m/s^2$~~

$S = ut + \frac{1}{2}at^2$

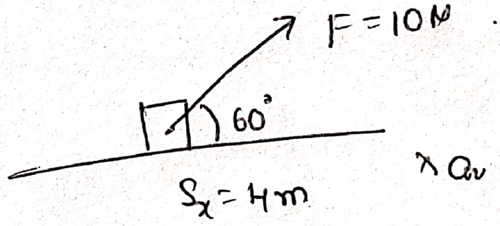
$= 2 \times 60 + \frac{1}{2}(0)t^2 = 120\,m$

$W = F \cdot S = 120 \times 5 = 600J$

⑲

Given $m = 5\,kg$

S_x



work done $= FS\cos\theta$

$= 10 \times 4 \cos 60$

$= 40 \times \frac{1}{2}$

$= 20J$